Claims

[1] A method for forming a light-emitting layer by atomic or molecular layer deposition, comprising the steps of:
1) placing a substrate in a reaction chamber and maintaining the inner temperature of the reaction chamber at a specific reaction temperature;
2) feeding a metal-containing material into the reaction chamber and reacting the material with the substrate; and
3) feeding an 8-hydroxyquinoline derivative into the reaction chamber and reacting the raw materials.

[2] The method according to claim 1, further comprising the step of removing unreacted raw materials and by-products by first purging after step 2) and prior to step 3).

[3] The method according to claim 1, further comprising the step of removing unreacted raw materials and by-products by second purging after step 3).

[4] The method according to claim 1, wherein steps 2) and 3) are repeated twice or more.

[5] The method according to claim 1, wherein the metal-containing material and the 8-hydroxyquinoline derivative are fed into the reaction chamber for 0.1~500 seconds.

[6] The method according to claim 2, wherein the first purging is carried out by absorbing and removing unreacted raw materials and by-products using a vacuum pump disposed in the reaction chamber.

[7] The method according to claim 2, wherein the first purging is carried out by supplying a purge gas selected from the group consisting of helium (He), hydrogen (H_2), nitrogen (N_2) and argon (Ar) to the reaction chamber, and absorbing and removing gases present in the reaction chamber using a vacuum pump disposed in the reaction chamber.

[8] The method according to claim 7, wherein the purge gas is supplied at a flow rate of 1~5,000 sccm for 0.1~500 seconds.

[9] The method according to claim 3, wherein the second purging is carried out by absorbing and removing unreacted raw materials and by-products using a vacuum pump disposed in the reaction chamber.

[10] The method according to claim 3, wherein the second purging is carried out by supplying a purge gas selected from the group consisting of helium (He), hydrogen (H_2), nitrogen (N_2) and argon (Ar) to the reaction chamber, and absorbing and removing gases present in the reaction chamber using a vacuum pump disposed in the reaction chamber.

[11] The method according to claim 10, wherein the purge gas is supplied at a flow rate of 1~5,000 sccm for 0.1~500 seconds.

[12] A method for forming a light-emitting layer by chemical vapor deposition, comprising the steps of:
1) placing a substrate in a reaction chamber and maintaining the inner temperature of the reaction chamber at a specific reaction temperature; and
2) simultaneously feeding a metal-containing material and an 8-hydroxyquinoline derivative into the reaction chamber with or without carrier gas and reacting the raw materials.

[13] The method according to claim 12, further comprising the step of removing unreacted raw materials and by-products by purging after step 2).

[14] The method according to claim 12, wherein step 2) is repeated twice or more.

[15] The method according to claim 12, wherein the metal-containing material and the 8-hydroxyquinoline derivative are fed into the reaction chamber for 1 seconds to one hour.

[16] The method according to claim 13, wherein the purging is carried out by absorbing and removing unreacted raw materials and by-products using a vacuum pump disposed in the reaction chamber.

[17] The method according to claim 12 and 13, wherein the carrier or the purge is carried out by supplying a gas selected from the group consisting of helium (He), hydrogen (H_2), nitrogen (N_2) and argon (Ar) to the reaction chamber, and absorbing and removing gases present in the reaction chamber using a vacuum pump disposed in the reaction chamber.

[18] The method according to claim 17, wherein the carrier gas or the purge gas is supplied at a flow rate of 1~5,000 sccm for 1~60 minutes.

[19] The method according to claim 1 or 12, wherein the reaction temperature is between 15°C and 500°C.

[20] The method according to claim 1 or 12, wherein the metal-containing material is selected from aluminum-, gallium- and zinc-containing materials.

[21] The method according to claim 20, wherein the aluminum-containing material is selected from the group consisting of:
trimethylaluminum (TMAl);
trimethylaluminum-dimethylethylamine (TMAl-DMEA);
trimethylaluminum-trimethylamine (TMAl-TMA);
trimethylaluminum-triethylamine (TMAl-TEA);
trimethylaluminum-methylpyrrolidine (TMAl-MP);
trimethylaluminum-ethylpyrrolidine (TMAl-EP);
trimethylaluminum-ethylpiperidine (TMAl-EPP);

trimethylaluminum-ethylmorpholine (TMAl-EMP);
triethylaluminum (TEAl);
triethylaluminum-dimethylethylamine (TEAl-DMEA);
triethylaluminum-trimethylamine (TEAl-TMA);
triethylaluminum-triethylamine (TEAl-TEA);
triethylaluminum-methylpyrrolidine (TEAl-MP);
triethylaluminum-ethylpyrrolidine (TEAl-EP);
triethylaluminum-ethylpiperidine (TEAl-EPP); and
triethylaluminum-ethylmorpholine (TEAl-EMP).

[22] The method according to claim 20, wherein the aluminum-containing material is selected from the compounds listed in Table 1.

[23] The method according to claim 20, wherein the gallium-containing material is selected from the compounds listed in Table 2.

[24] The method according to claim 20, wherein the zinc-containing material is selected from the compounds listed in Table 3.

[25] The method according to claim 1 or 12, wherein the 8-hydroxyquinoline derivative is selected from the compounds listed in Figure 4.

[26] The method according to claim 1 or 12, wherein the metal-containing material and the 8-hydroxyquinoline derivative are vaporized before being fed into the reaction chamber.